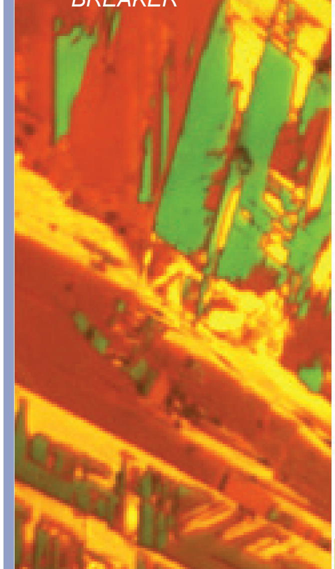
MST e NEWS
July 2011

INSIDE



James Gallegos

Smooth operator

By Francisco Ojeda
ADEPS Communications

Staring intently through the glass window into the hot cell, James Gallegos concentrates on maneuvering the remote manipulator's long arms to move radioactive material from one container to another.

Shielded from the radiation by the containment chamber's thick concrete walls, Gallegos squeezes the arm's metal hinge with his left hand to grab and pull tight the cable tie, closing the container. Then, with his right hand, he clenches the device's right arm and nimbly moves it left, so the arm shifts into position.

"It's like doing things backwards," said Gallegos, a material technician on the Nuclear Materials Science (MST-16) materials property team. "Every activity has to be thought out and carefully constructed."

Gallegos is adept at operating the remote manipulator, a mechanical device that allows a human operator to safely handle hazardous materials.

"Some people make it look easy; they develop a flow to their actions," Gallegos said. "For me, it became easy to operate because I understand the movements. It came naturally to me."

Gallegos has put those skills to work on the Laboratory's Off-site Source Recovery Project. Created in the late 1990s, the project, which supports the Laboratory's efforts to reduce global nuclear danger and secure nuclear materials, aims to remove excess, unwanted, abandoned, or orphan radioactive sealed sources that pose a potential risk to health, safety, and national security.

"It is nice to be working on a project that is important to the Lab's environmental and national security emphasis," Gallegos said. "We are doing a lot of great things to clean up radioactive material."

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Gallegos . . . The project has recovered more than 25,300 sources from more than 900 sites, including Puerto Rico and several foreign countries, resulting in more than 800,000 Curies of radioactive material being removed and secured.

Gallegos joined the project in 2001 when a supervisor recommended him to officials who were searching for an experienced manipulator operator. He frequently travels the Southwest in support of the project.

"I feel comfortable with the work. It's nice to be known as an expert in this area," said Gallegos, who has been at the Laboratory 26 years, 22 of them working with radioactive materials.

Gallegos began working with radioactive materials in 1989 as a measurement technician in Health Physics Measurements, repairing tools for handling radioactive materials. Three years later, his experience helped him become a radiological control technician for Health Physics Operations, where he used the tools to store radioactive material.

"He has a knack for making techniques more streamlined," said Jeremy Mitchell (MST-16), who has worked with Gallegos for six years. "He finds ways to improve a technique or tool. He takes it as a challenge."

For example, Gallegos has patented a ratcheting tool that makes closing and locking radioactive containers more efficient. He has a patent pending on a snap ring insert tool and has submitted for patents two other fixture tools.

Preparing samples

Currently, Gallegos's focus is preparing, mounting, polishing, and loading plutonium samples for two projects – one using Sandia National Laboratories' Z machine accelerator, the other a diamond anvil cell, a hand-held device that allows compression of a small piece of material to extreme pressures. Both projects aim to understand the behavior of plutonium in other materials under extreme environments.

Each project requires samples with specific dimensional requirements and prepared with a specific tolerance, polish, and assembly. The diamond anvil project requires plutonium material 30 microns in length and a specialized sample holder. For the Z machine project the material needs to contain a certain thickness and feature a disc shape 15 millimeters in diameter.

"James plays an integral role," said Nenad Velisavljevic (Shock and Detonation Physics, WX-9), who works with Gallegos on the diamond anvil project. "He is able to take metal samples that are already well studied and characterized by MST-16, cut down samples to a very small sample size, and load them into a diamond anvil cell."

What Gallegos enjoys most about Los Alamos, he said, is being able to interact with different people and the variety of work he encounters. "I don't get bored because I get to do a lot of different activities," Gallegos said. "I get to do so much and learn all the time."

James Gallegos's favorite experiment

What: Incident neutron irradiation and color center generation in lithium fluoride (LiF) windows used in actinide shock physics experiments.
When: 2010
Where: PF-4 facility at Los Alamos National Laboratory.
Why: We needed to define the lifetime for adhesives used to bind plutonium samples to windows made of LiF for high-strain rate experiments at the Z Accelerator, which is at Sandia National Laboratories. We were concerned that radiation damage may result in degradation of the bond, resulting in an interrupted shock loading of the sample.
How: We tested this by gluing similar assemblies and regularly observing their bond quality. We also verified performance by testing one of these assemblies using MST-16's 40-millimeter gun.
The a-ha moment: We discovered that we could promise performance of the samples up to three weeks following assembly. This provided some scheduling cushion for delivering the samples to Sandia.

Electron irradiations on nuclear energy fuel cycle waste forms

MST researchers are exploring silicate-based glass ceramics and titanate ceramics as alternatives to glass for nuclear waste form materials, the current baseline used for immobilizing alkaline/alkaline earth (CS) + lanthanide (LN) + transition metal (TM) fission-product waste streams generated by a uranium extraction (TRUEX) aqueous separations type process. Most of the self-irradiation in a waste form incorporating fission products is due to beta particle and gamma emission. These emissions cause radiation damage primarily via radiolytic processes, because both beta and gamma particles induce substantial electronic excitations in a target material. Electrons are useful to examine radiolysis effects because they deposit nearly all of their energy in solids via electronic loss processes. In this study, the scientists employed electron irradiations to simulate the self-radiation damage that occurs in a material incorporating nuclides undergoing radioactive decay.

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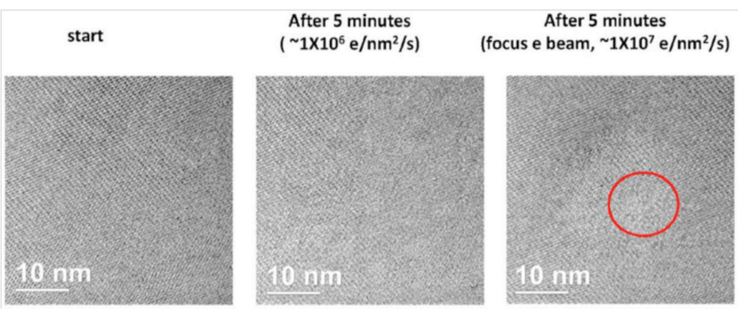
Electron . . . Ming Tang and Anna Kossoy-Simakov (Structure/Property Relations, MST-8) and Rob Dickerson (Materials Technology-Metallurgy, MST-6) performed a series of in situ electron irradiations using 300-keV electrons generated in a Tecnai F30 transmission electron microscope (TEM) in the Electron Microscopy Laboratory. By focusing electrons in the TEM on certain crystalline phases of these waste forms, it is possible to simulate radiolysis effects that might be experienced by potential CS/LN/TM silicate glass ceramic and titanate crystalline ceramic waste form.

In situ TEM observations suggest that these crystalline phases (such as oxyapatite, powellite) exhibit stability to 100 years at anticipated doses of approximately 10_{10} Gy. However, their stability may be rate dependent, which may limit the waste loading that can be employed. LANL, Pacific Northwest National Laboratory, and Savannah River National Laboratory collaborated on the research. The DOE Office of Nuclear Energy, Fuel Cycle Research and Development program funded the work, which supports LANL's Energy Security mission area and the Materials for the Future science pillar.

Technical contact: Ming Tang (MST-8)



High-resolution TEM images reveal that there is small change to the crystalline structure in the silicate mineral phase, powellite, following a dose at the level of 10_{10} Gy under intermediate electron flux (middle), but amorphous in red cycle area is found at a dose level 10_{11} Gy under high flux (right).

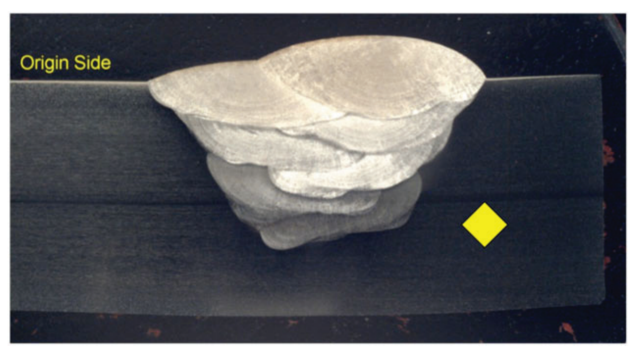
Using SMARTS to map residual stresses in a model dissimilar metal weld

About one-third of the beam time on the Spectrometer for Materials Research at Temperature and Stress (SMARTS) dedicated to spatially mapping residual stresses in finished industrial parts. SMARTS is analogous to a bathroom scale. You step on a spring, measure the compression of the spring, and knowing the spring constant, you calculate your weight from Hooke's law, F=-kx. The atoms of a crystal may be considered as being connected by springs. By measuring the change in spacing of the atoms in the crystal, the internal strains or ε, the stress is calculated from the generalized Hooke's law, $\sigma_{ij}=C_{ijkl}\varepsilon_{kl}$, assuming you know the "spring constant," that is the single crystal stiffness of the material. On SMARTS, we routinely map stresses in the bulk of materials with a spatial resolution of ~2mm.

As part of the national user program at the Lujan Neutron Scattering Center (LANSCE-LC), Thomas Sisneros and Don Brown (MST-8) and Bjorn Clausen (LANSCE-LC) collaborating with Matthew Kerr of the Nuclear Regulatory Commission (NRC) mapped the residual stresses in a model dissimilar metal weld, the like of which is found frequently joining nuclear reactor pressure vessels to relief valves. Mike Prime (Advanced Engineering Analysis, W-13) completed mechanical relaxation (the contour method) measurements of the residual stress in the same part as a means of cross validation. The image shows a cross section of the weldment with the integration area of the neutron diffraction measurement indicated by the yellow diamond. The base metal is ferritic steel and the weldment a nickel alloy. The change in chemistry complicates the measurement considerably.

The plot below shows a cross sectional map of the longitudinal stress in the model weld measured by neutron diffraction and mechanical relaxation; the agreement is satisfactory. The part is under a large tensile stress (>500MPa) parallel to the weld near the boundary between the weld and the base metal due to the differential heating experienced during welding. This is particularly troublesome because weld metals necessarily lack the "working" that most metals receive to enhance their mechanical properties and, thus, tend to be susceptible to stress corrosion under tensile stresses. These results are used to validate predictive finite element models developed by the NRC. The plot also shows the finite element calculations of the residual stress. While the model captures the correct magnitude of the longitudinal stress, the position of the maximum is not correct. Once validated, these models will be used to qualify welds for in-reactor service. The Lujan Center user program is funded by BES.

Technical contact: Don Brown



Cross section of the weldment with the integration area of the neutron diffraction measurement indicated by the yellow diamond. The base metal is ferritic steel and the weldment a nickel alloy.

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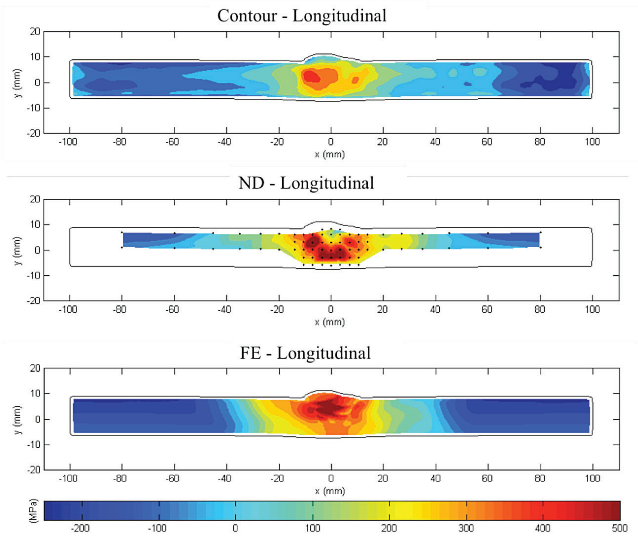


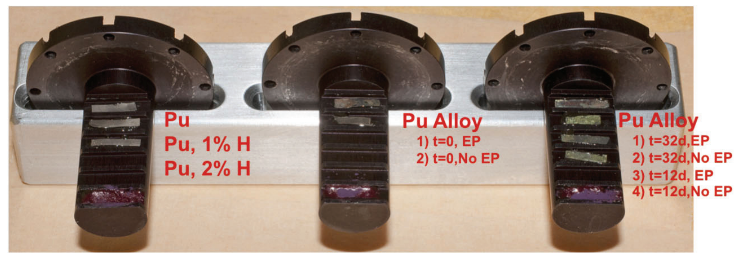
Cross-sectional map of the longitudinal stress in the model weld measured by neutron diffraction and mechanical relaxation.

Synchrotron studies of plutonium alloys and plutonium hydrides

The chemical processes involved in the corrosion and hydriding of plutonium metal alloys have yet to be fully understood. As part of an ongoing effort to elucidate these fundamental processes, plutonium metal alloys containing ~1.8 atomic% Ga were investigated using synchrotron x-ray diffraction (XRD) and x-ray absorption spectroscopy (XAS). XRD with depth profiling allows the long range order of the surface and subsurface (several microns) of the crystalline fraction to be investigated while XAS probes the short range order (up to 5 Å) of the material's amorphous components. Recent experiments were conducted at the Stanford Synchrotron Radiation Lightsource (SSRL) at the SLAC National Accelerator Laboratory in Stanford, Calif. Corrosion samples were exposed to air at 100% relative humidity at room temperature for 12 and 32 days and compared to samples with no exposure. Differences in surface preparation methods were also explored by comparing electropolished (EP) samples with those that were not electropolished (No EP). Hydrogen loaded samples consisted of plutonium alloys loaded with 0%, 1% and 2% hydrogen. Data analysis is currently underway but preliminary results for the corrosion samples indicate that XRD depth profiling was successful in determining the changing amounts of plutonium oxide, alpha- and delta-phase plutonium with penetration depth, providing a method of tracking the in-growth of plutonium oxide with time. In addition, the XRD results indicate that electropolishing successfully removed the surface alpha-phase plutonium layer induced by mechanical machining.

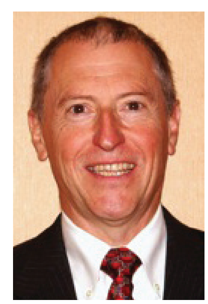
This work is in support of two LDRD DRs: "Molecular Forensic Science of Nuclear Materials" (Marianne Wilkerson, PI) and "Hydrogen Effects in Delta-Stabilized Pu Alloys: Fundamental Thermodynamics and Interactions at Reduced Dimensionality" (Dan Schwartz, PI). This work is a collaborative effort by Nuclear Materials Science, MST-16 (Alison Costello, Jeremy Mitchell, Dave Moore, Dan Schwartz, Franz Freibert, James Gallegos, Manny Chavez, Mike Ramos, Max Martinez, Ron Allen, Tom Baros, Steve Vigil, Scott Richmond), MST-8 (Steve Conradson), MST-6 (Patrick Kennedy), RP-1 (Julio Castro), and the Universidad Marista de Mérida, Merida, Mexico (J. Espinosa-Faller).

Technical Contact: Alison Costello



Plutonium/gallium samples for XRD/XAFS: Hydrogen loaded samples (left), Plutonium with no exposure (middle), 12 and 32 day exposure to 100% relative humidity in air (right). LaB6 standards are located in the bottom slot of all three holders.

Rusty Gray shares metallurgical wisdom at NSF workshop



The American automotive industry has an eye on magnesium - which holds the promise of bolstering fuel-efficiency - but this lightweight material is costly, more difficult to fabricate than other materials, and suffers from a poor performance record in regards to its high-strain rate ductility.

In May, during a two-day National Science Foundation workshop in Virginia, George "Rusty" Gray (MST-8) outlined one path that magnesium research could take given a better understanding of its service performance and its predictive capability. In his keynote lecture for the "Mg Science and Technology" workshop Gray reviewed the high-strain-rate and shock response of magnesium and addressed how dynamic properties influence the future design landscape for platform materiel.

"Perhaps much of magnesium's weakness is intrinsic, but there are opportunities here," he said.

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Gray... The automotive, aerospace, and defense industries await such developments. While Mg can offer the benefit of significant weight savings in structural applications, the use of Mg in current transportation and defense material systems poses unique challenges as well as opportunities. Widespread use of magnesium is not practical yet – and it may never be in many applications due to its limited fracture resistance under impact loading due to shear localization. In what Gray called a "decadal grand challenge," engineers and scientists should take what they know about scientific mechanisms and governing physics to build more robust, lightweight materials.

Progress on dynamic deformation and fracture predictive modeling requires new insight on deformation twinning, which is an active deformation mechanism in some materials and can even become a predominate mechanism at high strain rates. Los Alamos research has focused on materials with the hexagonal close-packed crystal structure and has included detailed microstructural characterization and modeling.

Gray serves on the National Materials Manufacturing Board, an organization of the National Academies. A Los Alamos National Laboratory fellow, Gray earned his bachelor's and master's degrees in metallurgical engineering from South Dakota School of Mines and Technology and his doctorate in metallurgical engineering from Carnegie Mellon University.

Technical contact: Rusty Gray

Celebrating Service

Congratulations to the following MST employees celebrating service anniversaries this month:

Mary Hill, MST-6	25 years
David Teter, MST-DO	15 years
Adam Farrow, MST-16	10 years
Stephanie Tornga, MST-7	5 years

HeadsUP!

Resetting a 15A or 20A, 120V electrical circuit breaker

Many of the buildings we occupy originally were designed and built for other purposes and in some locations we've reached the maximum capacity of the available power. Also, older buildings typically have single pane windows and lack good insulation leading to the use of portable space heaters in the winter and window air conditioners in the summer. As a result, it's not uncommon that you turn something on and a circuit breaker trips. Less commonly, a circuit breaker may fail due to age or wear and tear. That's the reason the facilities have a circuit breaker maintenance program. In fact, in FY10 circuit breaker inspections at LANSCE found about 20% failed, and failed and aging breakers forced work stoppages at Sigma (SM-66).

If you know which panel in your facility contains the circuit breaker that tripped, can you reset the breaker? The answer, unsurprisingly, is it depends; but first some background information.

Effective 1 March 2011 revision 1 of the Electrical Safety procedure (P101-13) became effective. This was a fairly extensive rewrite of the procedure with additional information from the National Fire Protection Association (NFPA) 70E document, "Standard for Electrical Safety in the Workplace." Translated, this means (among other things) that P101-13 addresses the arc-flash hazard, and that in turn results in requirements for personal protective equipment (PPE) when resetting a circuit breaker. The minimal PPE for resetting either a 15 amp or 20 amp circuit breaker is a cotton lab coat with long sleeves, long pants made of non-melting or untreated natural fiber material e.g. blue jeans, hearing protection, leather gloves, and safety glasses. For the purpose of resetting a circuit breaker, never wear a lab coat or pants made of a synthetic material (e.g., nylon) because in the event of an arc flash it not only will not protect you; it could melt on you and make an already bad situation worse.

For the resetting process you get one (1) try. If you are a qualified electrical worker (ESO or energized electrical worker training) and you have a reasonable certainty as to why the circuit breaker tripped, you may proceed as follows:

1. Turn off or disconnect the source of the fault or overload. Prepare for resetting the circuit breaker by putting on the minimum required PPE.

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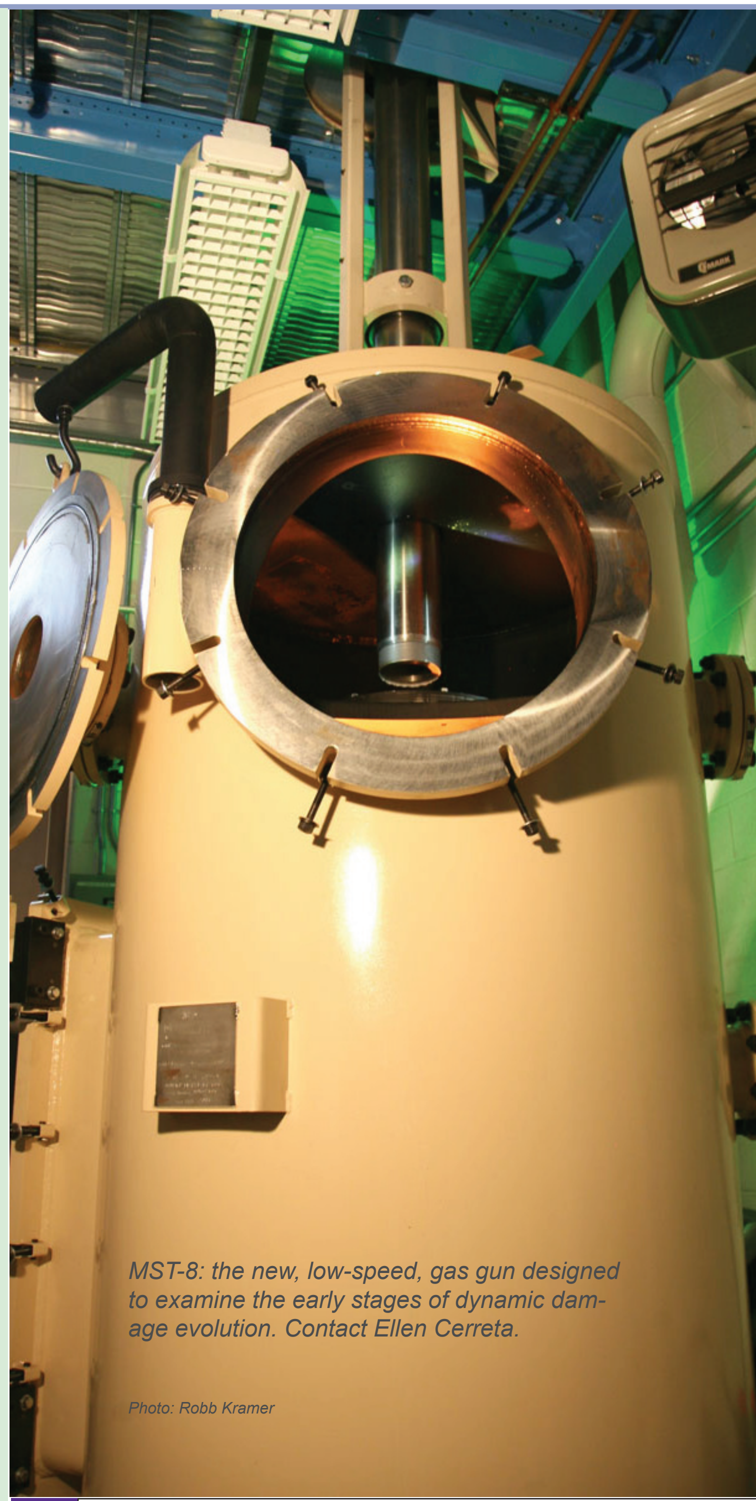
Resetting . . .

2. Standing off to the side of the panel, open the panel door and locate the tripped circuit breaker.
3. Make sure the circuit breaker is in its tripped state and not switched OFF. If you find the circuit breaker switched OFF, someone has positioned it that way. Either you have identified the wrong circuit breaker or someone else got to it ahead of you and you need to find out more information from your facility/maintenance coordinator. Until you know, you're done for the time being, so close the panel door and go get some answers or help
4. If tripped, switch the circuit breaker to the OFF position. Then, switch the circuit breaker to the ON position.
5. a. If the circuit breaker stays ON you're done. Close the panel door. You can now remove the PPE.

   b. If the circuit breaker trips again, there's more to the electrical fault situation than you initially realized. In any case, you're done. Close the panel door and remove the PPE. Last, but not least, contact your facility/maintenance coordinator for assistance.

Regardless of whether your attempt to reset a circuit breaker was successful, inform your facility/maintenance coordinator about the trip event. Repeated tripping of a circuit breaker causes wear that can lead to failure of the circuit breaker and that can be a serious situation.

For more information about the arc-flash hazard and resetting a circuit breaker, see P101-13, Section 6.4.4, "Arc-Flash Hazards," and Section 6.4.11, "Other Precautions for Personnel Activities, paragraph A, Operating Circuit Breakers or Fused Switches."



MST-8: the new, low-speed, gas gun designed to examine the early stages of dynamic damage evolution. Contact Ellen Cerreta.

Photo: Robb Kramer

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